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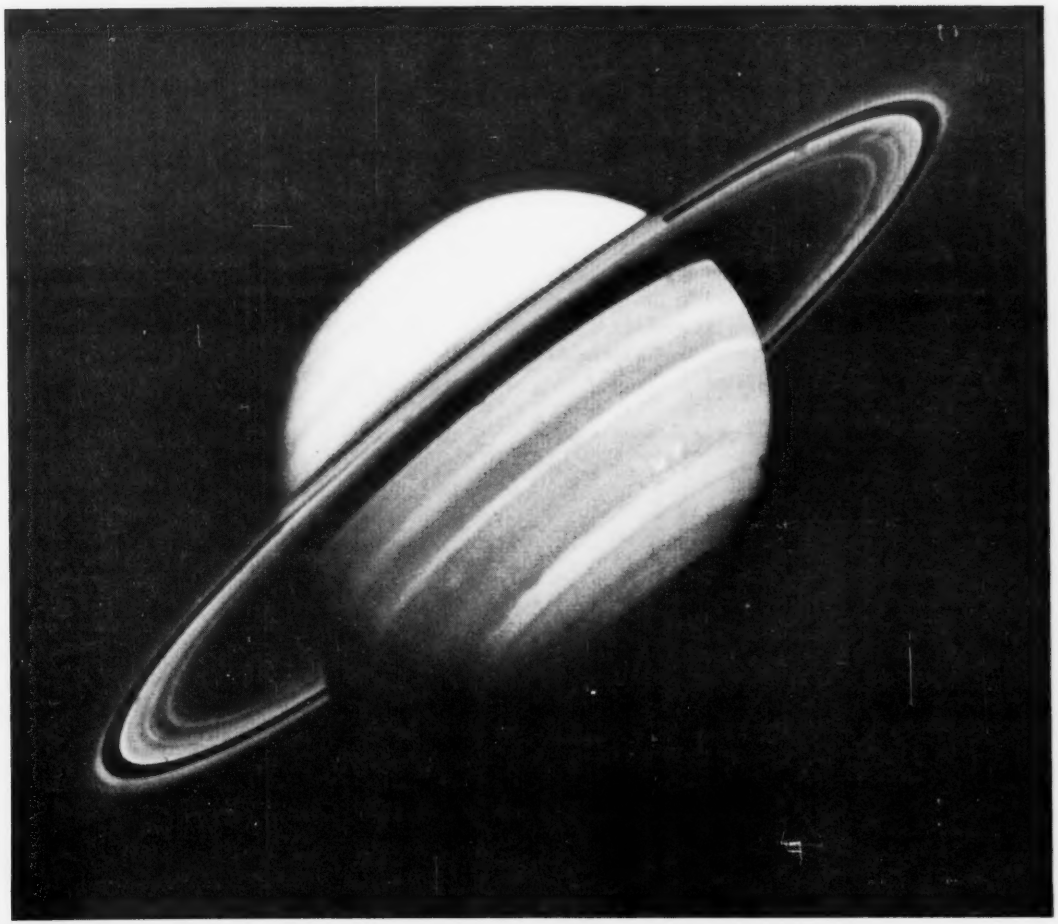
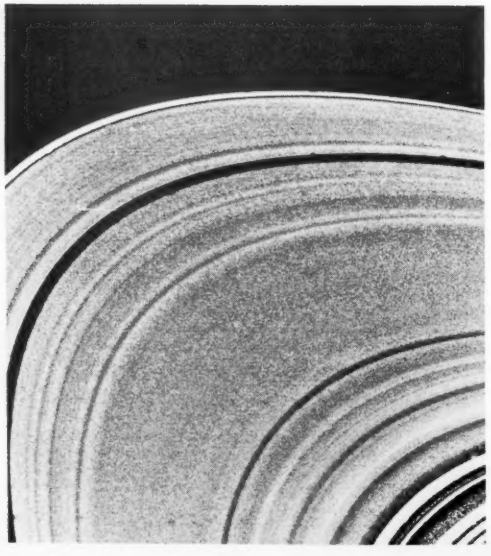


About the Cover

Inbound image of Saturn taken by Voyager 2's cameras as the spacecraft traveled toward the closest approach with the ringed planet on Aug. 25. This photo was taken from a distance of 27 million miles. At closest approach, Voyager 2 passed within 63,000 miles of the planet's cloud tops.

Shown below is a Voyager 2 image of Saturn's A-ring, taken Aug. 23 from a range of 1.7 million miles. The Encke Division is the prominent dark gap in the A-ring. The inner F-ring shepherding satellite, 1980S27, is visible near the top of the frame.



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Letter from Washington

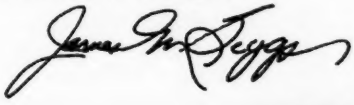
Dear Colleagues:

As the Voyager 2 spacecraft continues its incredible journey away from Saturn toward a rendezvous with Uranus in 1986 and possibly Neptune in 1989, I want to congratulate the Voyager team members for their splendid achievement.

We can only guess at what Voyager will discover in the future. But there can be no guessing about the importance of our planetary exploration program and the great technological achievement it represents.

Measured by any other Nation's activity in this area, we are doing much more than the rest of the world. And I plan to do all I can within budgetary constraints to keep us on track on several important missions—Galileo, Space Telescope and Venus Orbiting Imaging Radar.

Our planetary exploration program has been a source of great national pride and important new knowledge not only for our scientists, but for the scientists around the world. I plan to work hard to rejuvenate and strengthen it.

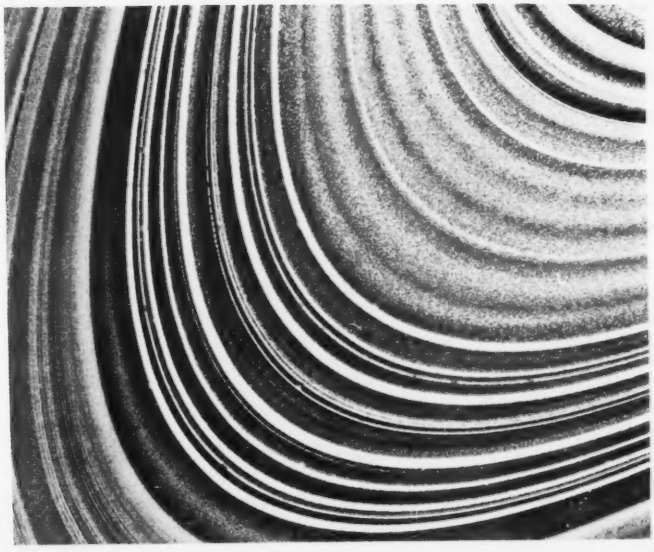


Voyager 2 Saturn Mission Complete Success

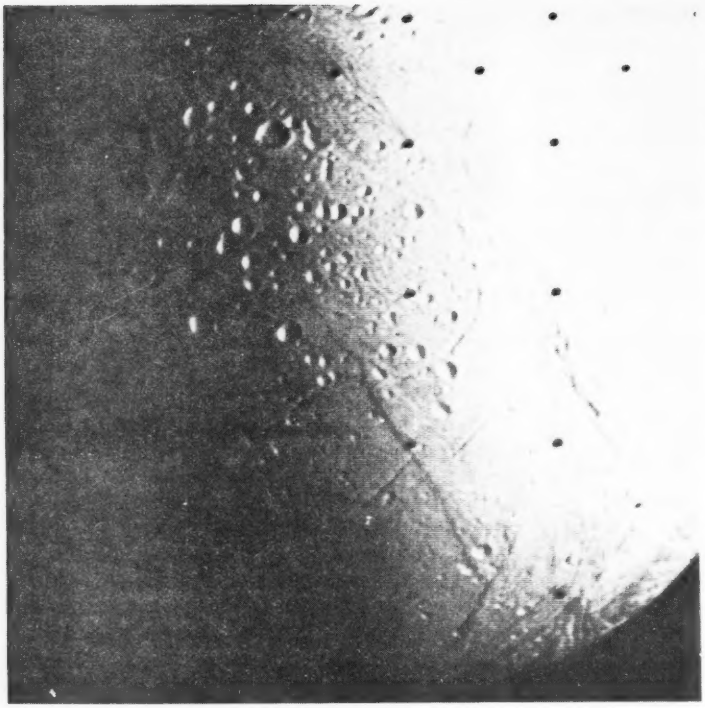
Voyager 2's mission to Saturn brought it 14,300 miles closer to the ringed planet than the previous encounter by its twin spacecraft, Voyager 1, last Nov. 12. Voyager 2 passed within 63,000 miles of the planet's surface at closest approach on Aug. 25, at 9:50 PDT. At the conclusion of its mission, Voyager 2 took more than 18,000 photos of Saturn and is now on it way to a January 1986 encounter with Uranus. Voyager project scientist Ed Stone declared the Voyager 2 mission a 200 percent success.

Voyager 2 took higher resolution photographs of five satellites: Enceladus, Tethys, Hyperion, Iapetus and Phoebe.

Voyager 1 photos of Enceladus showed the planet had a very smooth, uncratered surface, which intrigued project scientists. With Voyager 2's closer look at the planet, Enceladus was revealed to have a widely varied topography which indicated a difference in its geological thermal history. Truncated craters, grooved terrain, collapsed craters and the absence of craters in other areas were all revealed in Voyager 2's images. Scientists believe the planet's age to range from 100 million years old in some parts—the age of the Dinosaur—to a few billion years old in other areas. The varied topography of Enceladus is believed to have been the end result of



More than 60 bright and dark ringlets are evident here. This Voyager 2 image focuses on Saturn's eccentric C-ring. This photo was taken Aug. 23 from a range of 1.7 million miles.



Surface of the Saturnian moon Enceladus taken Aug. 25 when Voyager 2 passed within 69,500 miles of the planet. A widely varied topography is evident—moderately cratered areas have been transected by strips of younger grooved terrain. The grooves and linear features indicate that the satellite has been subjected to considerable crustal deformation as a result of internal melting.

tidal heating—frictional heat produced with the expansion and contraction of the planet's crust.

The largest crater found in the Saturnian system has been seen in Voyager 2 images of Tethys taken from a distance of 621,000 miles. The crater is approximately 250 miles in diameter with a central peak and a ring of mountains surrounding it. The crater is so large that the Saturnian moon Mimas could fit inside it. The crater measures one-third the diameter of Tethys—the same ratio as the large Mimas crater to the diameter of Mimas.

Views of Hyperion showed the planet to be an extremely irregular body which has been described as a "thick hamburger patty." Its size is about 186 miles across with a thickness of about 124 miles. The axis of this disc-shaped satellite is peculiar—it appears to be sitting at an angle to the orbital plane. Scientists have theorized that the panet may have been hit by some object which jostled it into this position; evidence of cratering has been seen which might support this theory. Hyperion's appearance was a complete surprise to scientists—Voyager 1's images revealed a surface which appeared very uninteresting.

Images of the Saturnian moon Iapetus show one side to be very dark with a surface reflectivity of only 4 to 5 percent— equivalent to some of the darkest surfaces on Earth. Radio science data collected from Voyager 2 has revealed the density of Iapetus not to be a 1.3 solar mix of constituents which would indicate a 40 percent rock and 60 percent water ice composition. Instead, Iapetus has been shown to have a 1.1 solar mix of constituents which indicates a composition of 35 percent rock, 55 percent water and 10 percent methane.

The 1.1 density indicates the presence of solid methane; a 1.3 density, the presence of solid water. The new compositional mix of Iapetus may provide clues to the dark side of this satellite. If the lower density of Iapetus is due to the incorporation of methane at the solar composition mix, it suggests that there are billions of tons of carbon in the methane which would have some bearing on the production of the black material—in short, the portion of Iapetus which is dark as pitch is black because of its composition.

Voyager 2's closest approach to Phoebe occurred on Sept. 4. The spacecraft traveled within 1,290,000

miles of the planet's surface. Images received from this encounter are a first—Voyager 1 did not attempt to photograph Phoebe because of its great distance from this moon at closest approach. If upon analysis of these images scientists find a surface likeness which parallels the planet Iapetus, this will support a theory that the dark side of Iapetus developed as a collective process from particles in the atmosphere and not from its compositional mix.

Voyager 2 extensively studied the ring plane of Saturn taking higher resolution photographs than did Voyager 1. Saturn's ring plane is unparalleled in the solar system—a system more complex in structure and dynamics than was previously known before the Voyager missions.

Particular areas of concentrated study by Voyager 2 in the 43,000-mile ring plane were the B-ring and its spokes; the braided F-ring and its satellites; the eccentric rings (C-ring and one in the Cassini Division) and the Encke Division.

Photopolarimeter observations of the occultation of rings by the star Delta Scorpii were highly successful providing remarkably detailed data on the ring structure. Analysis of this massive amount of data continues; final results will yield a map of an area the size of the United States with the resolution of a city block.

Voyager 2 discovered a new "kinked" ring inside the Encke Division. Because it looks similar to the F-ring, scientists are rethinking their theories about the cause of the knotted characteristics of the F-ring. Previously it was thought that the wobbly character of the F-ring was caused by the presence of gravitational pull of its shepherding satellites, 1980S26 and 1980S27.

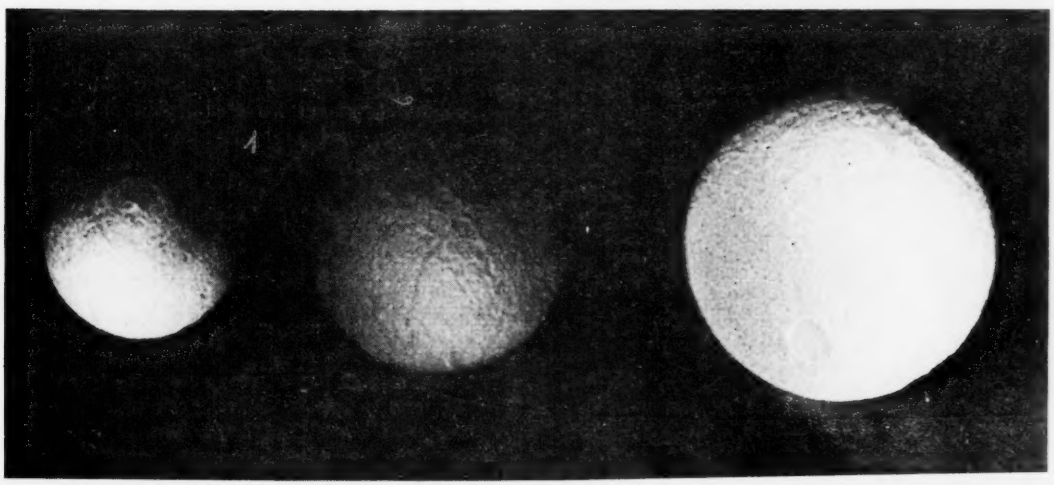
The new ring in the Encke Division has no satellites seen as close as a 6-mile resolution. And analysis of imagery of the F-ring and its shepherding satellites revealed no satellite effects on the ring structure—no ring perturbations were seen due to the presence of the satellites which could have caused the peculiar braiding.

In addition, photopolarimetry measurements of the F-ring indicate 10 strong optical depth variations in the ring—a bright high optical depth at the outer edge to gradients inward. Also, four additional attenuations (dips in star light) were discovered 249 miles beyond the F-ring which may prove to be ringlets.

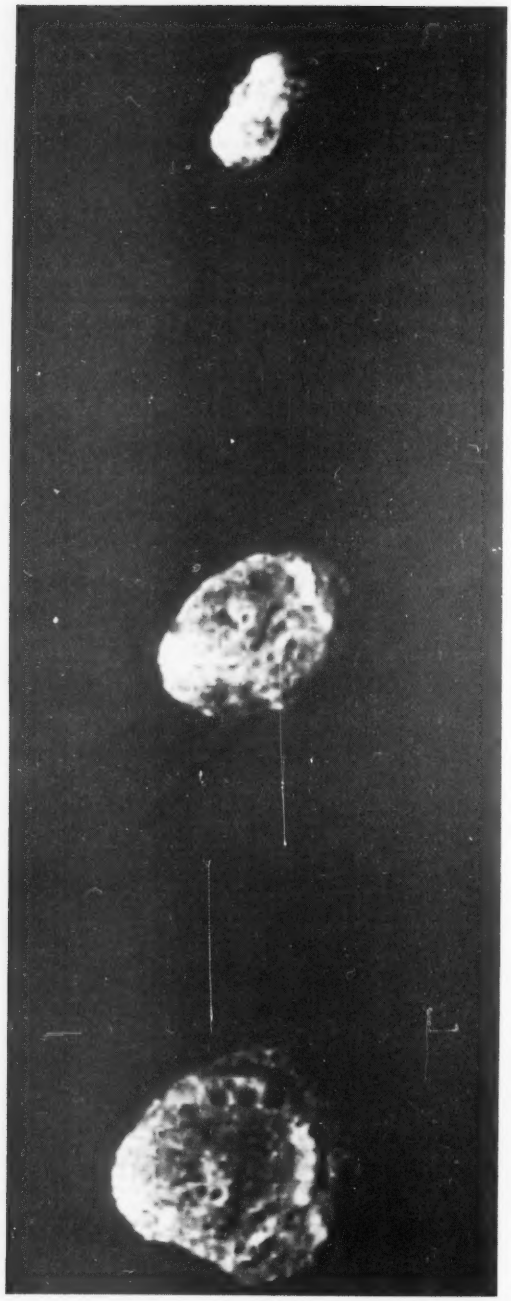
Color enchancement of the B-ring has shown the ring not to be homogeneous as to its color on the surface; spectrophotometry of the particles has shown them to be variable from one point to another.

A movie was made from the series of images taken of the B-ring and its spokes; a time lapse sequence of this movie revealed complex activity in the spokes—some seem to form, others to shear out and others appear to fade away. Detailed analysis of the B-ring spokes and their activity continues.

Imagery taken by Voyager 2 reveals the A-ring to be reddish in color but the Cassini Division shows a bluish color similar to the C-ring. This could indicate a similar composition to the C-ring. The



These Voyager 2 images of Tethys show its distinctive large crater, 250 miles in diameter, as it rotates toward Saturn. These images were obtained at four-hour intervals beginning late Aug. 24 and ending early the next day.



Three views of Hyperion taken by Voyager 2. Top view was taken Aug. 23 from a distance of 740,000 miles; middle view on Aug. 24th from 430,000 miles; the bottom view, Aug. 24th from a distance of 310,000 miles. The surface of Hyperion is pock-marked with many meteorite impact craters; it is possible that one of these impacts jostled Hyperion into its current gravitationally unstable position.

C-ring appears in color images to be less red than the B-ring. Some features in the C-ring have the same color as the B-ring which indicates these rings may be of similar composition. Color differences also indicate imperfect separation of ring material in the C-ring.

Voyager 2's planetary radio astronomy and plasma wave instruments obtained more high resolution data within Saturn's magnetic field than collected by Voyager 1. Planetary radio astronomy obtained high resolution data near the rings in an attempt to determine the origin of electrical discharge signals first recorded by Voyager 1.

Voyager 2 data has shown that the sound emissions from Saturn occur in two patches, one in the northern hemisphere of the planet and one in the southern hemisphere, relative to the position of the Sun to these patches. The northern patch straddles the noon meridian and the auroral zone with the patch in the southern hemisphere in a comparable position in that region.

Voyager 2's infrared interferometer spectrometer data has revealed that the temperature of Saturn is correlated as a function of latitude or height; temperature ranges from 80 degrees Kelvin to 92 degrees Kelvin. Temperature gradients also correlate with the position of the wind jets observed by the imaging team. Horizontal temperature gradients are a large source of potential energy; it can be inferred from the gradients that changes in the horizontal wind field correlate to the function of height in a vertical direction—wind speed changes with latitude or height.

Voyager 2 has detected much greater detail of Saturn's jet streams than Voyager 1 discovered. Three definite easterly flows can be seen at northern latitudes. The jets extend to higher latitudes on Saturn than they do on Jupiter. The zonal profile of Saturn does not appear to correlate with the light and dark bands in the clouds. An anticyclonic counterclockwise feature, resembling a reversed figure 6, can be seen at 72 degrees north, 155 miles across, with a center convective region of about 37 miles. A similar feature can be seen at about 50 degrees north.

Voyager 2 took high-resolution photos of seven of Saturn's newly discovered satellites: 1980S26 and 1980S27, the pair that shepherds the F-ring; 1980S6, the satellite that occupies Dione's orbit; 1980S1 and 1980S3, the two moons that share an orbit; and 1980S25 and 1980S13, the two satellites recently discovered in Earth observations that orbit Saturn about 60 degrees behind and ahead of Tethys.

The seven appear to be irregularly shaped and

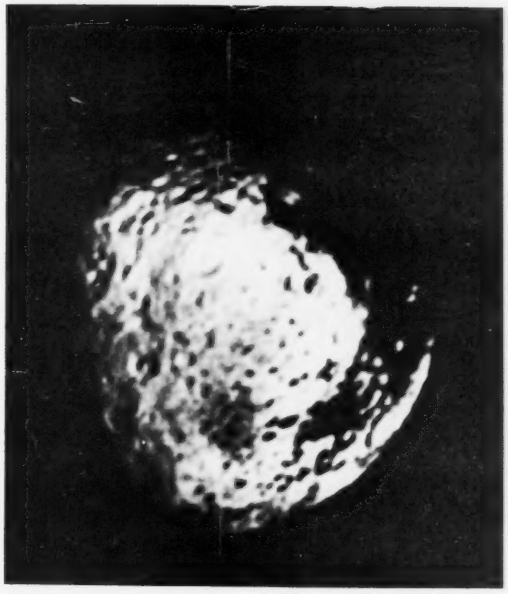
heavily cratered by impacts with cosmic debris. They range in size from 6 to 200 miles across. 1980S3 appears to be very irregular and heavily battered. Scientists believe it was once half of a satellite which was split into two—with the leading satellite, 1980S1, being the other half.

At 10:26 p.m. PDT on Aug. 25, Voyager 2 entered Saturn/Earth occultation—where Voyager disappeared behind Saturn as viewed from Earth. At this point, receipt of signals from the spacecraft ceased until 12:01 a.m. PDT, Aug. 26. Ring plane crossing occurred approximately 54 minutes after closest approach (9:50 p.m. PDT, Aug. 25) while Voyager 2 was blocked from earth view. This region was Voyager 2's "Uranus aim point", required to bend its flight path and place it on a trajectory to Uranus.

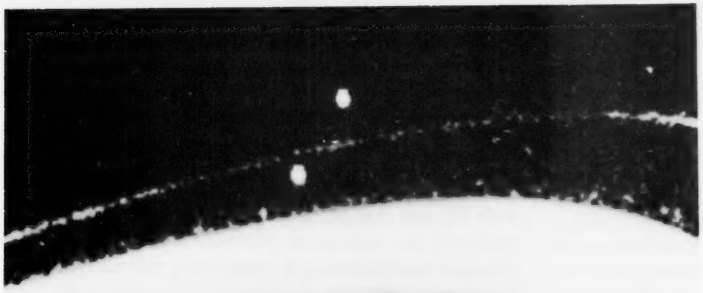
Approximately 30 minutes after reaquisition of signal from Voyager 2 at 12:30 a.m. PDT, Aug. 26, evidence that the spacecraft had successfully crossed the ring plane of Saturn, project scientists discovered that the scan platform had become stuck in its rotation at 260 degrees azimuth. In this position, the Voyager 2 cameras were pointed out into space. This platform holds the narrow and wide angle cameras, the infrared radiometer, ultraviolet spectrometer and photopolarimeter instruments.

Because of this platform problem, it appeared that the outbound imagery of Saturn would be lost as well as the closest approach with Phoebe. However, project scientists discovered that the stickiness and slowness of movement (from lower to higher azimuth) continued to improve with use.

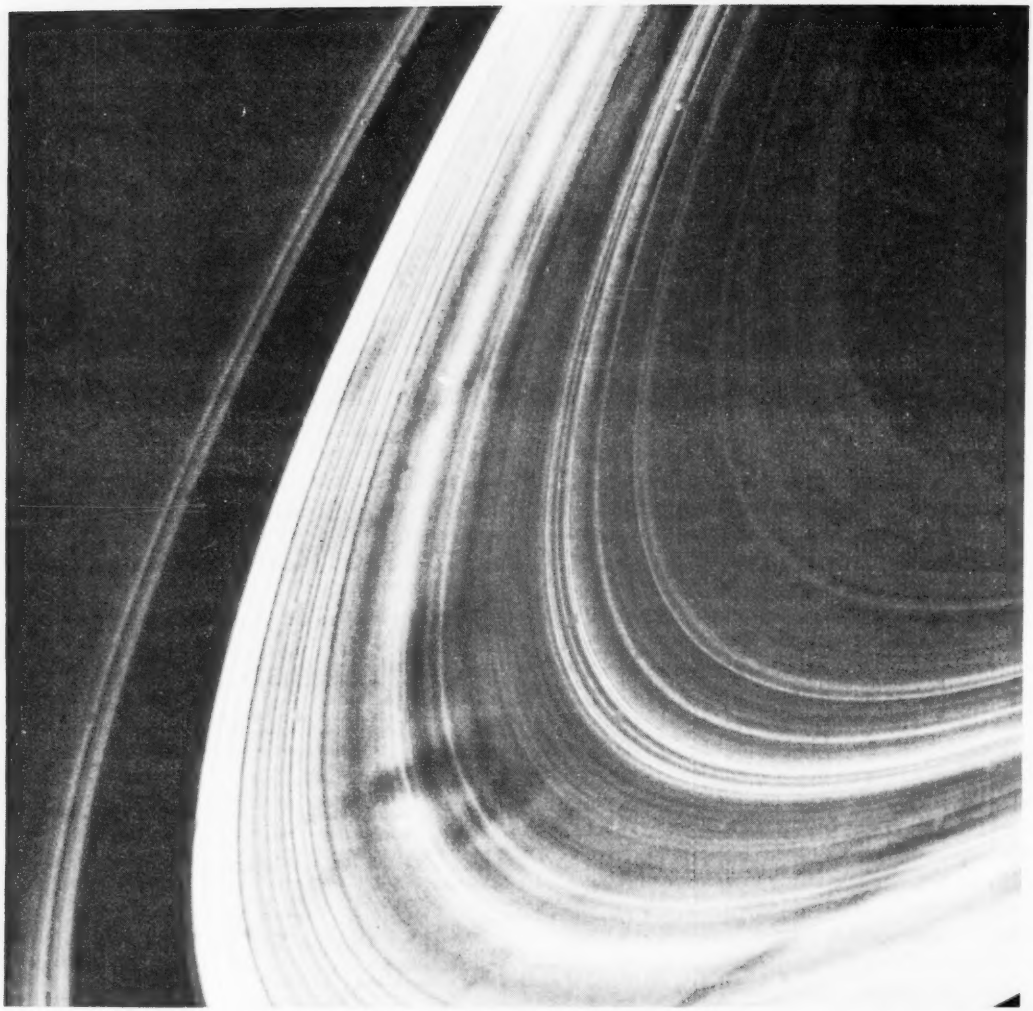
Thus the decision was made to use a manual drive to move the platform from the 260 degree azimuth position to one of 209 degrees on Aug. 28 in order



Iapetus, the Saturnian moon whose surface is composed of a light and dark side as photographed by Voyager 2 from a distance of 680,000 miles on Aug. 22. The dark material of much interest to scientists is seen here on the right side of the planet.



Saturn's F-ring shown bracketed by its two shepherding satellites, 1980S26 and 1980S27. This image was taken Aug. 15 at a distance of 6.6 million miles from Saturn. Closer observations showed no evidence of gravitational pull upon the F-ring by these satellites which was thought to have been a possible cause for the braided effect of the ring.



Voyager 2 high resolution image of Saturn's rings taken Aug. 23 at a distance of 2.5 million miles. Evident are the numerous "spoke" features in the B-ring. Their sharp, narrow appearance suggests short formation times.

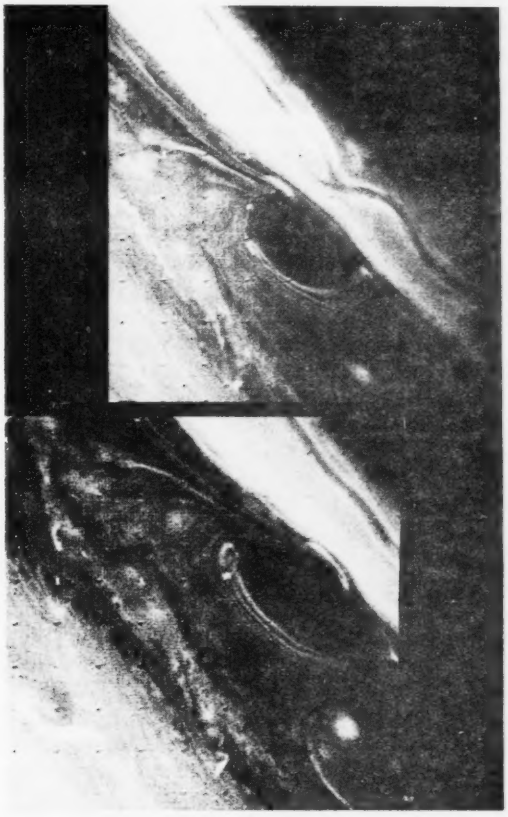
to begin transmission of wide angle photography of Saturn as Voyager 2 sped outbound from the planet enroute its 1986 Uranus encounter. It was determined that the Uranus azimuth was the same value as the 209 degree Saturn azimuth.

Thus with this manual move, data collection for the planned Uranus encounter was not endangered. The decision also was made on Aug. 28 to roll the entire spacecraft to bring Phoebe into view and preserve the planned imagery of this distant moon.

Response of the platform continues to improve with use and it is expected to be functioning normally for the Uranus encounter. All eleven of the onboard experiments are functioning normally. Dependent upon the condition of spacecraft subsystems, Voyager 2 will continue on from Uranus to an August 1989 encounter with Neptune. Voyager 2 traveled more than 1.24 billion miles to encounter Saturn and will travel an additional 1.76 billion miles for the Uranus encounter.

Voyager 2 was launched Aug. 20, 1977 from Cape Canaveral, Fla., aboard a Titan-Centaur rocket combination. There are more than 120 project scientists involved in the Voyager program; personnel involved in the mission control/navigation/computer phases which includes tracking stations and personnel at NASA's Jet Propulsion Laboratory, Pasadena, Calif., totals an additional 500 individuals. Both Voyager spacecraft were designed and built by the Jet Propulsion Laboratory, a NASA-owned facility operated for the space agency by the California Institute of Technology. The Jet Propulsion Laboratory manages the Voyager project for NASA.

Voyager 2's observation of the northern mid latitudes revealed two anticyclonic counterclockwise jet stream features resembling a reversed figure 6. The feature shown is located approximately 50 degrees North latitude. The ribbonlike structure is located at 47 degrees North latitute in the white cloud region of Saturn. Voyager 2 took this image Aug. 16 from a distance of 5.8 million miles.



Circulation around a large brown spot in Saturn's atmosphere seen in images by Voyager 2 on Aug. 23 and 24 from distances of 1.7 million and 1.4 million miles, respectively. Top photo was taken 10 hours, 15 minutes before the bottom frame. This anticyclonic motion is associated with downdrafts that would induce clearing over the spot. Consequently, the spot itself may represent an opening in Saturn's upper cloud deck through which darker underlying clouds can be seen. The smallest features visible here are more than 30 miles across.

Venus Atmospheric Circulation Described by Pioneer

Venus' predominant weather pattern is a high-speed circulation of the middle and upper atmosphere around and around the planet, from east to west, at velocities up to 362 kilometers per hour. This and other new information has emerged from a complete analysis of Pioneer Venus spacecraft data.

Superimposed on these high-velocity, planet-circling winds are lower-speed winds blowing north and southward from the equator to the poles. Wind and temperature measurements taken from the four Pioneer probes which were widely scattered over the planet indicated that these north and south winds make up a series of equator-to-pole circulation cells, stacked one on top of the other with each of the upper three cells counter-rotating as gears do.

All of the winds in these equator-to-pole circulation loops are driven by the solar energy absorbed primarily in Venus' dense, high-cloud layer.

The whole complex of stacked circulation cells carries Venus' solar heat, absorbed near the equator, to the polar regions. Because Venus' rotation is so slow (243 days for one axial rotation), rotation forces do not break up these huge, hemisphere-spanning circulation loops as they do to similar ones on faster spinning Earth.

These two kinds of circulation, around the planet, and equator to poles, cause the atmosphere to thoroughly mix. This means it is about the same temperature and pressure at the equatorial and polar regions, and on the day and night sides.

The four Pioneer Venus probe craft measured the planet's atmosphere from top to bottom in four locations on day and night sides of the planet on Dec. 9, 1978. The Orbiter has been making pictures and other observations of the planet for the past two years and will continue to do so through 1985. All six Pioneer Venus craft (including the probe-carrying bus) arrived at the planet in December 1978.

While Venus' atmosphere behaves differently than Earth's, understanding of Venus' weather is helping with understanding such Earth weather phenomena as heat trapped by the "greenhouse effect," transport of heat to the polar regions, and interactions between the lower atmosphere and the stratosphere. Venus' equator-to-pole winds are all much slower than its round-the-planet winds and are superimposed on them resulting in winds that blow mostly around the planet, but also spiral up toward the poles. Winds in the top half of the clouds move toward the poles; in the bottom half of the loop, Pioneer probe wind measurements showed that the winds travel in the opposite direction from poles to equator. In these clouds warmed air rises at the equator, spills over toward the poles, descends as it cools and flows back toward the equator, where it is rewarmed and goes around again endlessly.

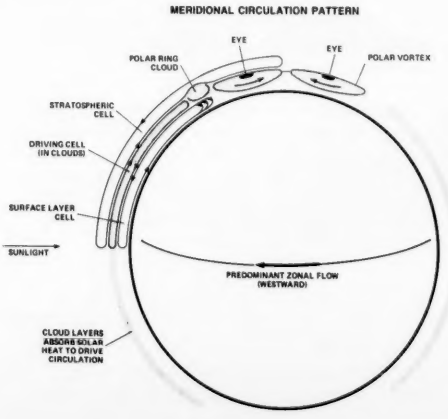
Above the cloud level is a stratosphere cell, from 65 to 85 km altitude. This cell is not driven by solar heat, but is geared by friction to the cloud cell, and therefore runs in the opposite direction. Below the cloud cell, from 45 to 40 km is a similar sub-cloud cell, also "geared" to the cloud cell and also, therefore, running in the reverse direction to it. Near Venus' surface, there is believed to be a surface circulation cell in the dense, sluggish lower atmosphere, driven directly by the relatively small amount of solar heat absorbed at the Venusian surface.

Between the surface cell and the sub-cloud cell, 30 to 40 km altitude, there may be very large eddies which are probably horizontal instead of vertical because the atmosphere is stable and not convectively overturning at their altitudes.

The termination of the cloud cells at the poles seems to result in large-scale turbulence in the form of double vortices rotating around each other.

These descending vortices were unexpected, and the evidence for them is two "hot spots" rotating around each other. Seen by Pioneer infrared sensors, such hot spots are explained by Dr. Fred Taylor, Jet Propulsion Laboratory, Pioneer infrared investigator, as the result of lower, hotter levels of atmosphere made visible by holes in the clouds.

The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, Calif. The spacecraft were built by Hughes Aircraft Co., El Segundo, Calif.



Energy Absorption Studied to Reduce Aircraft Crash Forces

Energy absorption is a concept that could save lives in airplane crashes.

Americans fly a large number of lightweight, general aviation airplanes. One goal of the NASA/Federal Aviation Administration aircraft safety research programs is to give occupants a better chance to survive if the plane crashes. An aircraft subflooring strong enough to bear the stresses of flight, yet capable of being crushed to a predetermined level when subjected to crash impact loads, may help save lives.

Since the mid-1970's, NASA and FAA have been studying the crash dynamics of light planes. In 1977, they began an in-depth look at the energy-absorbing characteristics of aircraft subflooring.

By redesigning the interior floor, researchers hope to reduce the crash forces that can be transmitted to people inside the plane. Other work is aimed at improving the energy absorption characteristics of aircraft seats and restraint systems.

NASA energy-absorbing configurations were first tested in a machine that slowly compressed the subfloor structure. Other test articles were hoisted about 3 meters and dropped. Each subfloor section had mounted to it the equivalent mass of two seats and their occupants. The concept of transforming a 15-centimeter subfloor into a crush zone with collapsible members was proven worthy of advanced testing.

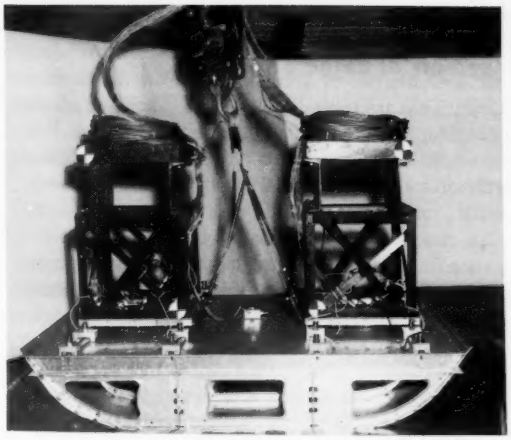
Theory indicates that the energy from a velocity change of 26 kilometers per hour at 25 G's crushing force is the maximum energy a 15-cm subfloor can absorb. Tests of the subfloor sections have proven that these design concepts are on the right track and test floors are getting near the maximum amount of energy absorption possible.

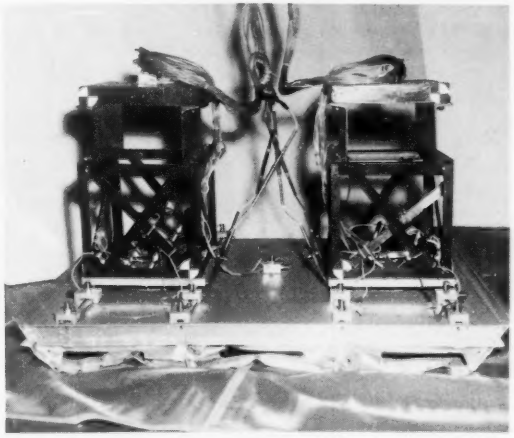
In future tests, two designs will undergo full-scale plane crashes at the Impact Dynamics Facility at NASA's Langley Research Center, Hampton, Va. One advanced section and one mini-mod section will serve as the passenger area subfloor to compare results.

In these tests, the planes will be swung by cables, pendulum style, from the top of the outdoor gantry onto a concrete pad more than 60 meters below. The cables will be pyrotechnically severed at the last moment and the rocket-assisted planes will freely impact at a forward speed of 120-128 km/hr.

An airplane seat is capable of absorbing even more crash impact energy than the subfloor, allowing the occupant several inches to come to rest in a crash. An energy-absorbing seat, anchored to a sturdy floor, takes a share of the jolt by "giving," to more gently lower its occupant toward the floor. Various seat concepts are being considered both at Langley and at the FAA's Civil Air Medical Institute in Oklahoma City.

The research on crash dynamics is being expanded to jet transports and will complement current NASA/FAA research aimed at enhancing occupant survivability in post-crash fires.





NASA energy-absorbing drop test. Top photo shows an experimental subfloor section, above which an equivalent mass of two seats and their occupants have been mounted. Photo below shows that the "crush zone" (with collapsible members) has done its job of energy absorption while the floor has remained intact.

NASA-Langley Researchers Study Space Assembly of Large Structures

A possible assembly line in space is being studied at NASA's Langley Research Center, Hampton, Va., that would allow astronauts to construct large platforms or antennas in Earth orbit from the Space Shuttle.

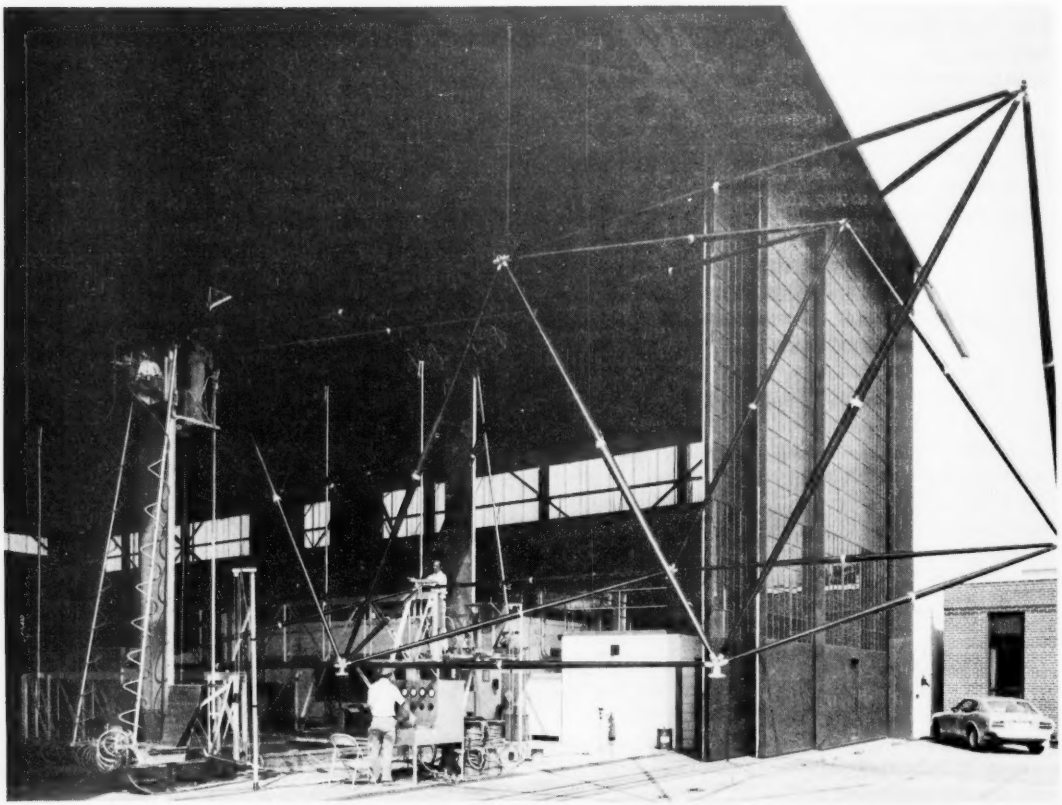
The concept uses a mobile work station to position a pair of pressure-suited astronauts so they can move horizontally and vertically within a prescribed area to build space systems that are too large or complex to fold up and transport aboard the Shuttle.

The mobile work station is designed to be located inside the Shuttle Orbiter's payload bay or to be a free flyer, operating near the Orbiter.

A large-scale experimental model of the mobile work station is being tested at Langley. The ground test model will enable researchers to uncover difficulties that might be encountered in space and identify assembly aids to improve astronaut productivity.

Two astronauts would be attached to the station by foot restraints, freeing their hands for assembly tasks, and enabling them to move around and build large platforms without using great amounts of effort. The astronaut work platforms, one on each side of the mobile station, would be electrically operated, either from the platform or from within the Orbiter's flight deck.

The horizontal and vertical freedom of movement would allow the astronaut team to put together elements of a structure with relative ease. When a



Researchers at NASA Langley use a mobile work station to construct a beam from graphite epoxy conical tubes. The concept, designed for possible installation aboard the Space Shuttle, would allow a pair of pressure-suited astronauts to assemble large structures in space.

section of a structure is completed, it would be moved along the assembly line and the astronauts would extend its size by adding more elements or equipment. The concept was tested under normal Earth gravity conditions at Langley during July and August and will be tested under simulated space weightlessness conditions in the Neutral Buoyancy Facility at NASA's Marshall Space Flight Center in Huntsville, Ala., in September.

This facility is a large water tank which employs neutral buoyancy techniques to simulate weightlessness. Researchers will conduct tests to gain basic information about the productivity of astronauts building large space systems.

The experimental work station will be used to construct large truss segments from lightweight, graphite-epoxy conical tubes that can be stacked compactly, like plastic cups, inside the Orbiter for transport into space. A pair of conical tubes are joined at their large ends to form a strut about 5.4 meters (18 feet) long. Truss structures are assembled from these struts by joining their ends without tools, using quick-attachment cluster joints developed at Langley. The truss structures may be formed as antennas, beams, or platforms for large solar power or communication systems.

Ames and Dryden Center Consolidation to Begin Oct. 1

A plan for the consolidation of NASA's Ames Research Center, Mountain View, Calif., and Dryden Flight Research Center, Edwards, Calif., has been approved by NASA Administrator James M. Beggs. Under the plan, Dryden on Oct. 1 will become a directorate of Ames Research Center.

Dryden will retain its name and its essential identity but will function as an operational element of Ames, reporting to Ames Director, C.A. Syvertson. Under this "one-management concept," the aeronautical research activities at the two locations will be integrated and all staff functions for the two centers will be combined. Several Ames research aircraft will be moved to Dryden.

"I am firmly convinced that Ames and Dryden can be merged into a single effective and efficient organization for the conduct of advanced aeronautical research," Syvertson said in reporting the consolidation plan to Ames and Dryden personnel.

There will be no forced relocations and no layoffs as a result of the consolidation, Syvertson said.

Although the consolidation plan becomes effective Oct. 1, it is projected to take 30 months to implement fully. Ames research aircraft such as the Quiet Short-Haul Research Aircraft and the Tilt Rotor Research Aircraft will be moved to Dryden over the 30-month period. They will be moved at times which will have minimal impact on their research programs.

One of the two Rotor Systems Research Aircraft and two support aircraft will remain at Ames. Aircraft under the Ames Astronautics Directorate, such as the Kuiper Airborne Observatory and the Earth Resources Survey Aircraft (U-2 and ER-2) also will remain at Ames.

Indonesia Building Landsat Ground Station

NASA Administrator James M. Beggs and Dr. R. Sunaryo, chairman of the Indonesian National Institute of Aeronautics and Space (LAPAN), recently signed a Memorandum of Understanding for the establishment of a Landsat ground station at Pekayon, near Jakarta, Indonesia.

The agreement will permit LAPAN to operate a ground station at Pekayon and to receive, process, archive and disseminate Landsat data.

The Landsat satellites provide Earth observation data for a wide variety of uses, such as crop monitoring, resource assessment and pollution monitoring.

The agreement provides that LAPAN will make the Landsat data it receives available on a public, non-discriminatory basis to anyone requesting it.

As a result current and prospective Landsat users in the Indonesian archipelago will be able to obtain regular, timely data coverage of their region.

In addition to construction and operational costs associated with its ground station, LAPAN also agrees to pay NASA the current annual access fee of $200,000 beginning after the first six months the Indonesian station begins receiving data.

Ten foreign Landsat ground stations are already in operation outside the United States: Prince Albert, Saskatchewan and Shoe Cove, Newfoundland, Canada; Cuiaba, Brazil; Fucino, Italy; Kiruna, Sweden; Tokyo, Japan; Hyderabad, India; Alice Springs, Australia; Mar Chiquita, Argentina; and Harbeesthoek, South Africa. Procurement of ground station equipment is underway in Thailand and China and other ground stations are in the planning stages.

U.S. ground stations for Landsat are located at Fairbanks, Alaska; Goldstone, Calif.; and at NASA's Goddard Space Flight Center, Greenbelt, Md.

Space Shuttle Launch Date Rescheduled

Launch date for the second Space Shuttle mission from the Kennedy Space Center, Fla., has been rescheduled from Sept. 30 to Oct. 9, 1981.

NASA officials explained that the decision to delay the launch was based upon a number of small problems encountered in preparing the STS-2 vehicle for the second flight and an intent to prevent launch crew fatigue.

A loss of five launch preparation days in the vehicle Assembly Building was attributed to minor problems such as alignment of Orbiter and external tank connections and delays in the Shuttle Surface Interface Test.

Launch crews will work a six-day week instead of seven days and will have the Labor Day weekend off. Also, it is estimated that the thunderstorm season will account for some lost time during the afternoons that the Shuttle is on the launch pad.

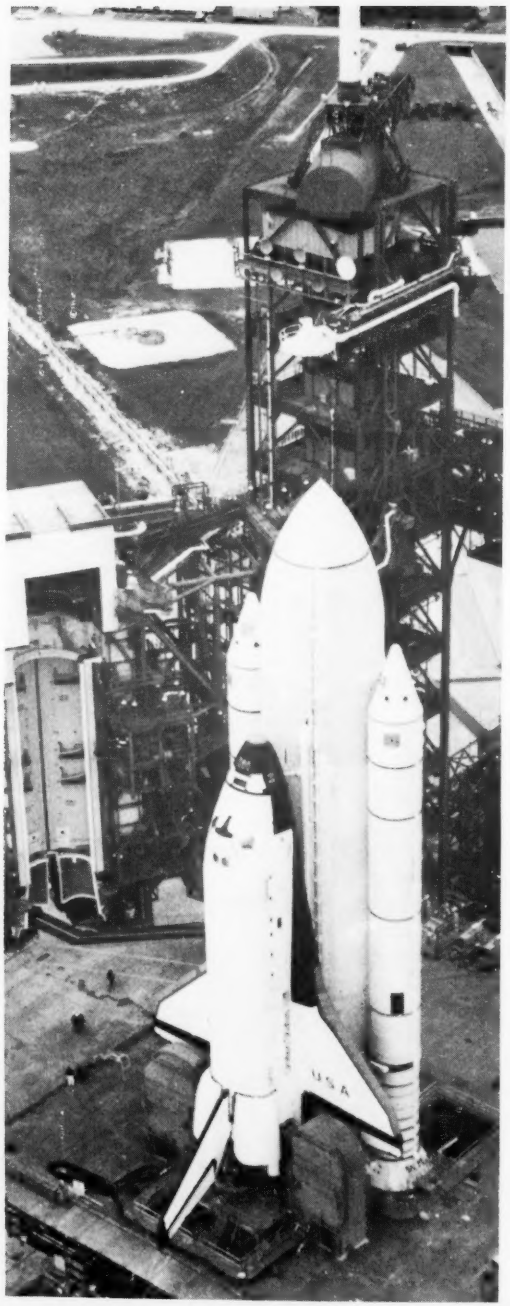
"Father" of NASA Spacecraft Design Retiring

Maxime A. Faget, "father" of Mercury, Gemini, Apollo and Space Shuttle spacecraft design, is retiring from government service shortly after the STS-2 mission, now scheduled for launch no earlier than Oct. 9.

He has served as Director of Engineering and Development at NASA's Johnson Space Center, Houston, since 1961. In this position, he is responsible for the design, development and proof of performance for all spacecraft systems. His area includes crew systems, experiment systems, telemetry and communications, guidance and control, avionics systems engineering, propulsion and power, future programs, structures and mechanics, and spacecraft design and engineering analysis.

Faget joined NASA's Langley Research Center, Hampton, Va., in 1946 as a research scientist for pilotless aircraft. He later was named as Head of Performance Aerodynamics, a post he held until 1958.

Faget was selected to serve in the original group of thirty-five assigned as the nucleus of the Johnson Space Center (then the Space Task Group)*, and served three years as Chief of the Flight Systems Division. Just prior to this period (1958–61) he conceived and proposed the development of the one-man spacecraft used in Project Mercury. The Gemini and Apollo spacecraft are derivations of his original basic concept.



Space Shuttle Columbia, once again at Kennedy Space Center's launch pad 39A ready to undergo final preparations before the spacecraft's second launch on Oct. 9.

As a NASA member of the Polaris Missile Steering Task Group, he greatly influenced the design of that Navy missile.

Faget's achievements, honors, awards and technical papers reflect a "Who's Who" of aerospace. He holds patents on a "Mach Number Indicator" and "Space Shuttle Vehicle and System" and joint patents on the "Aerial Capsule Emergency Separation Device" (escape tower), the "Survival Couch" and the "Mercury capsule."

Faget said he plans to remain closely associated with the space program as a consultant and also to investigate some energy conservation proposals.

*On Jan. 3, 1961, NASA's Space Task Group—an autonomous subdivision of Goddard Space Flight Center that managed Project Mercury and was housed at Langley Research Center, was made an independent NASA field installation. Following congressional endorsement of President Kennedy's decision to accelerate the U.S. manned spaceflight program, Congress in August 1961 appropriated funds for a new center for manned spaceflight. On Sept. 9, 1961, NASA announced that "Manned Spacecraft Center" would be built at Clear Lake, near Houston, Tex., and on Nov. 1, 1961, Space Task Group personnel were told that the "Space Task Group is officially redesignated the Manned Spacecraft Center." Known as Manned Spacecraft Center for 11½ years, the Center was responsible for design, development and testing of manned spacecraft; selection and training of astronauts; and operation of manned space flights—including the Mercury, Gemini, Apollo and Skylab programs and the U.S.-U.S.S.R. Apollo Soyuz Test Project. It was lead center for management of the Space Shuttle program.

Kerrebrock Named as Head of NASA's Aeronautics Office

Dr. Jack L. Kerrebrock became NASA Headquarters' Associate Administrator for Aeronautics and Space Technology effective July 1. He replaces Dr. James J. Kramer who retired in October 1979.

Kerrebrock formerly had served as Head of the Department of Aeronautics and Astronautics at Massachusetts Institute of Technology.

Kerrebrock has taught and conducted research in energy conversion and propulsion since 1956 when he received his Ph.D. degree from California Institute of Technology. He was an aeronautical research scientist at Lewis Research Center, Cleveland, of the National Advisory Committee for Aeronautics, from 1951 to 1953.

His early work was on nuclear rockets, space propulsion and power, and magnetohydrodynamic generators. More recently, he has been involved with the fluid mechanics of turbomachinery for aircraft engines, and is the author of a text on aircraft engines and gas turbines.

He was the director of the M.I.T. Gas Turbine Laboratory from 1968 to 1978 and is the first to be appointed as the Richard Cockburn MacLaurin Professor of Aeronautics and Astronautics, a title established in memory of M.I.T.'s sixth and youngest president.

New Faces at Headquarters

Paul Courtney Simmons, Conoco Inc., one of twenty-five 1981-82 Presidential Exchange Executives from the private sector, began a one-year assignment with NASA on Sept. 1. As Special Assistant to the Office of Associate Administrator for Space and Terrestrial Applications, he will study program planning and recommend improvements in the integration of program planning, budget planning, and technology transfer.

Mr. Simmons has degrees in civil and environmental engineering from Polytechnic Institute of New York, and in finance and economics from the University of Southern California. His experience includes airport facilities design, gas processing plant engineering, market research and economic studies, transfer pricing systems design, domestic and foreign business development and liaison for Federal and state regulatory compliance operations.

Major Howard Patrick Sweeney, U.S. Air Force, one of fifteen 1981-82 White House Fellows, also began a one-year assignment with NASA on Sept. 1. As Special Assistant to the Office of the Administrator, he will provide special staff and liaison support.

Major Sweeney has degrees in political science and law from Loyola University, Los Angeles, Calif., and is a member of the California Bar. His experience includes judge advocate, civil/criminal/military affairs, military judge, law professor, legislative liaison, and investigative and intelligence assignments.

Contractor News

NASA's Jet Propulsion Laboratory, Pasadena, Calif., has requested proposals from two aerospace companies for full-scale development of the Venus Orbiting Imaging Radar spacecraft. The proposals went to **Hughes Aircraft Co.**, Los Angeles, and **Martin Marietta Aerospace**, Denver. These two companies had previously completed phase B definition studies for NASA in 1980. The proposals are due by the end of September with selection of a spacecraft contractor sometime early next year. The proposals will cover the design, fabrication and testing of a flight model of the spacecraft including integration of other major elements of the project such as the synthetic aperture radar (being separately developed under another request for proposal) and the science instruments.

Modular Computer Systems, Inc., Ft. Lauderdale, Fla., has been awarded a multimillion dollar supplemental contract by NASA's Kennedy Space Center, Fla., to provide for minicomputers and computer peripheral equipment to be installed in the Space Shuttle Launch Processing Systems at Kennedy and at Vandenberg Air Force Base in California. The minicomputers and computer support equipment are to be installed in the Checkout, Control and Monitor Subsystems, an integral part of the Launch Processing System. The Launch Processing System provides the bulk of the checkout work for the reusable Shuttle Orbiter, and a large percentage of that for the External Tank and Solid Rocket Boosters. The Launch Processing System facilities are located at the Kennedy Space Center, where NASA's Space Shuttle is presently launched from, and at Vandenberg Air Force Base in California, where Shuttle launches will be scheduled for no earlier than 1985. The fixed-price contract is for $4,322,000 and covers the period from July 1, 1981 through December 31, 1982.

PRC/Government Information Systems, McLean, Va., has been selected for negotiations leading to award of a contract for the operation and maintenance of the NASA Headquarters Automated Services Facility in Washington, D.C. The one-year cost-plus-award-fee contract will begin Dec. 1, 1981. The contract will have firm option provisions for two one-year extensions; two additional one-year extensions are anticipated. The contractor's estimated cost for the first year of operation is approximately $3.7 million and approximately $11.7 million for the first three years, exclusive of any fee.

Boeing Services International, Inc., Kennedy Space Center, Fla., has been awarded a supplemental agreement to an existing contract with the Space Center to perform ground support operations services for a fifth contract year at Kennedy. The value of the cost-plus-award-fee agreement is $63,381,627 and brings the aggregate contract value to $257,242,135. The one-year supplemental contract covers the period from July 1, 1981 through June 30, 1982. Ground support operations include operation and maintenance of the huge crawler transporters used to transfer the Space Shuttle to the launch pads. Other functions include handling toxic wastes, operation of heavy equipment such as the cranes used in the Vehicle Assembly Building and the Orbiter Processing Facility, minor repairs to KSC buildings and facilities, and general office moving functions.

New IG–June Gibbs Brown was sworn in as NASA's second Inspector General on July 27 at a ceremony held at NASA Headquarters, Washington, D.C. Officiating was NASA Administrator James M. Beggs (right); at center is Ms. Brown's husband, Dr. Ray L. Brown.

Did You Know?

NASA is accepting accreditation requests for news media to cover the second orbital flight test of the Space Shuttle. Launch is scheduled for no earlier than Oct. 9 from Kennedy Space Center, Fla., with mission control at Johnson Space Center, Houston, and landing at Dryden Flight Research Center, Edwards, Calif., or White Sands Missile Range, N.M. about five days later. The news center will open at Kennedy 10 days prior to launch, at Johnson and Dryden five days prior to launch. Decision on the status of White Sands will be made at a later date.

Requests for accreditation must be made by a news executive on company letter head, clearly indicating the assignment (reporter, photographer, technician, etc.) of each individual. Freelance writers and photographers must offer proof of assignment or evidence of professional activity. The accreditation will be valid for all news centers. Requests should be submitted by Sept. 23 to: NASA Headquarters, Code LFD-10 Accreditation, Washington, D.C. 20546. Please indicate from which location(s) you plan to cover the mission.

Idea Clearinghouse cites NASA's Lewis Research Center, Cleveland, Ohio, for installation of an infrared sensor activated fire control system in their airplane hangar. In structures with high ceilings and few walls and equipment to act as barriers, a conventional roof-mounted smoke detector and sprinkler system would be unable to prevent the spread of a costly fire. Although this equipment has been commercially available for a number of years, the Lewis application is unique within NASA. This system can automatically discharge a foam/water mixture over a 21,000 square foot area at a rate of 3,400 gallons-per-minute. This system can also be manually operated for any desired time period. For additional information, contact Jack Colegrove, Chief of the Lewis Safety Office at (FTS) 294-6211.

Priscilla Elfrey is the first Headquarters employee selected for the agency Career Development Program which since 1973 has given 140 Center employees experience working at Headquarters. Priscilla, a Headquarters Executive Resources and Development Manager, began a one-year assignment at Kennedy Space Center, Fla., Sept. 1. She will work as a special assistant at KSC in external relations and employee development. She will continue projects identifying, advising and developing executives with emphasis on shuttle operations management.

Awards Corner

Dr. Joseph S. Heyman, NASA Langley Research Center, Hampton, Va., received a **Space Act Award** for $2,500 and a **Certificate of Recognition** for his invention of "CdS Solid State Phase Insensitive Ultrasonic Transducer." Ultrasonic measurements are made by transmitting an ultrasonic wave into a sample and then measuring the reflected waves. If the sample is inhomogeneous with nonparallel reflecting surfaces, the reflected waves will not be in phase. These phase differences in the reflected waves result in inaccurate measurements when made by conventional transducers; Heyman's ultrasonic transducer will make accurate measurements even though the reflected waves may be out of phase. Space Act Awards are monetary awards given for creating and reporting new concepts and technology to NASA.

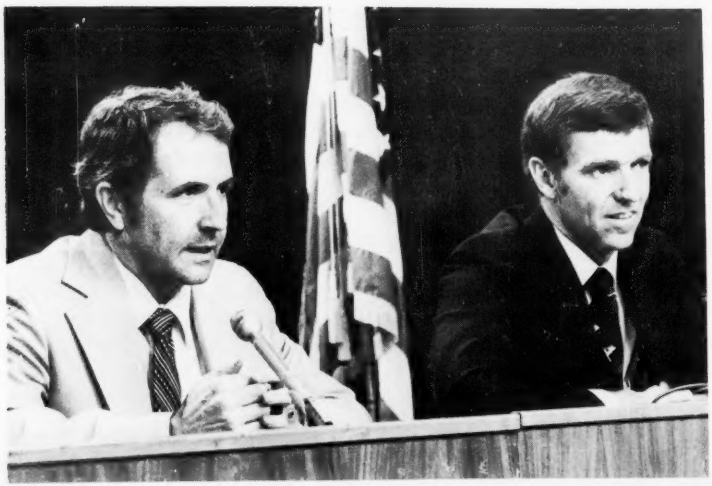
John N. Perry, General Engineer, U.S. Army Aeromechanics Laboratory, Ames Research Center, received a **Special Achievement Award** including a check for $600 in recognition of Perry's work in designing and making a precision tool that improves the tolerances of a low cost electro discharge machine with no further modification. The tool was based on an idea formulated by **James M. Peterson**, Engineering Technician with the Planning Office at Ames. Peterson received a check for $750 for his suggestion. The new tool, built from off-the-shelf parts, adapts existing, relatively common, low-cost electric discharge machines to do the work of scarce and very expensive models. In dollar terms, the new tool can transform $50,000 to $100,000 vertical drive electro discharge machines to $150,000 to $200,000 horizontal drive machines for a conversion cost of only about $5,000; these machines are used for two dimensional air foil work. The tool could save Ames Research Center approximately $100,000 per year.

Phillip R. Compton, Program Manager, Energy Systems Division, NASA Headquarters Office of Aeronautics and Space Technology, received an Outstanding Service Award from the Virginia Society of Professional Engineers. Compton served as the Society's chairman of the Community Action Committee. He was cited for "his initiation of a program of engineering assistance to Virginia communities through enthusiastic and tireless exploration of means and methods in which he involved all regions and chapters." Compton is currently the Vice President of the Northern Region of the Virginia Society of Professional Engineers.

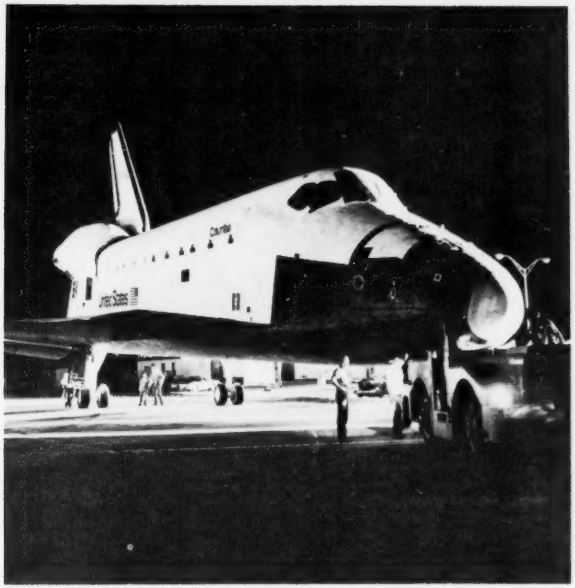
Patents for Inventions from NASA Research

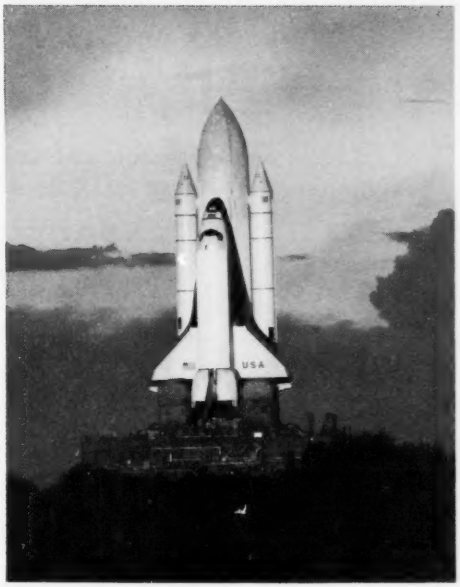
The office of General Counsel, NASA Headquarters, announces that the following U.S patents have been issued by the U.S. Patent and Trademark Office to NASA for inventions resulting from NASA research. Inquiries concerning them should be directed to the attention of the NASA Patent Counsel of the indicated installation.

Inventor(s) & Employer	Title	Patent No.	Installation
Taylor G. Wang and Daniel D. Elleman ..... Caltech/JPL, Pasadena	Method and apparatus for producing concentric hollow ..... spheres	4,279,632	NRO
Patricia A. Brown and Joan Vernikos-Danellis . San Jose University San Jose, Calif.	Indomethacin-Antihistamine combination for gastric ..... ulceration control	4,279,906	ARC
David H. McCann, Marvin H. White, and ..... Alfred P. Turly, NASA/GSFC and Westing-house Electric Corp., Baltimore, Md.	Time delay and integration detectors using charge transfer .... devices	4,280,141	GSFC
Frank Lombardi, Caltech/JPL, Pasadena	Head for high speed spinner having a vacuum chuck	4,280,689	NRO
Willis C. Ross and Raymond Goldstein Caltech/ JPL, Pasadena	Optical gyroscope system	4,280,766	NRO
Terry L. St. Clair and John M. Butler, ... Blacksburg, Va.	Tackifier for addition polymides containing monoethyl- ..... phthalate	4,281,102	LaRC
Nelson J. Groom, Williard W. Anderson and .. William H. Phillips, NASA/LaRC	RIM inertial measuring system	4,281,384	LaRC
Lawrence D. Wing and Joseph W. ..... Cunningham, NASA/GSFC	Automatic thermal switch	4,281,708	GSFC
Gordon J. Deboo and David Joseph Devine, ... NASA/ARC	Electrical short locator	4,282,479	ARC
Jacob J. Gustincic, Caltech/JPL, Pasadena	Microwave limb sounder	4,282,525	NRO
Robert James, James and Associates, Lancaster, Calif.	System for providing an integrated display of instantaneous ... information relative to aircraft altitude, heading, altitude and horizontal situation	4,283,705	DFRC
James R. Currie, NASA/MSFC	Multi-channel temperature measurement amplification system	4,282,752	MSFC
James W. Akkerman, NASA/JSC	Reciprocating engines	4,283,995	MSC
Robert R. Belew, NASA/MSFC	Biocentrifuge system capable of exchanging specimen cages ... while in operational mode	4,284,034	MSFC
Anne K. St. Clair, Terry L. St. Clair, and Larry . T. Taylor, Old Dominion University Norfolk, Va.	Aluminum ion-containing polyimide adhesives	4,284,461	LaRC
Richard P. Tschirch and Kenneth R. Sidman, .. Arthur D. Little, Inc., Cambridge, Mass.	Heat sealable, flame and abrasion resistant coated fabric	4,284,682	JSC



Prime crew for the second Space Shuttle flight at a pre-flight press conference at NASA's Johnson Space Center, Houston, on Aug. 3: Joe H. Engle (right), commander; and Richard H. Truly (left), pilot. The Columbia's second launch is scheduled for Oct. 9.





Rollover of the Space Shuttle Columbia (photo at left) from the Orbiter Processing Facility to the Vehicle Assembly Building at Kennedy Space Center, Fla., on Aug., 10. Rollout of Columbia (right) on Aug. 31, mated with a new external tank and solid rocket boosters atop the giant mobile launcher platform. Rollout began at 4:45 a.m. EDT; the Columbia was at pad 39A at 12:05 p.m.

Expendable Launches for 1981

Name	Launch Date	Vehicle	Range	Mission Remarks
COMSTAR-D	February 21	Atlas Centaur	ESMC	Comsat General Corp. communications. Reimbursable.
Navy 20 (NOVA 1)	May 15	Scout	WSMC	DOD transit. Reimbursable.
GOES-E	May 22	Delta	ESMC	NOAA weather. Reimbursable.
Intelsat V-B	May 23	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
NOAA-C	June 22	Atlas-F	WSMC	NOAA weather. Reimbursable.
Dynamics Explorer	Aug 3	Delta	WSMC	NASA scientific.
FLTSATCOM-E	August 6	Atlas Centaur	ESMC	DOD communications. Reimbursable.
Solar Mesosphere Explorer	October	Delta	WSMC	NASA scientific.
SBS-B	September	Delta	ESMC	SBS communicatons. Reimburseable.
RCA-D	October	Delta	ESMC	RCA communications. Reimbursable.
NOAA-D	October	Atlas-F	WSMC	NOAA weather. Reimbursable.
Intelsat V-C	November	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
RCA-C1	December	Delta	ESMC	RCA communications. Reimbursable.
Intelsat V-D	December	Atlas Centaur	ESMC	Intelsat communications. Reimbursable.
Navy 21 (NOVA 2)	4th quarter	Scout	WSMC	DOD transit. Reimbursable.

Space Shuttle Launches for 1981

Orbiter	Launch Date	Launch Site	Payload
OV-102	April 12	KSC	
OV-102	Oct. 9	KSC	OSTA-1 DFI (with IECM)

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Protective Coatings

NASA spacecraft technology has resulted in a spinoff application used in pharmaceutical coating and packaging processes.* Under a NASA contract for use in the Apollo program, General Magnaplate Corp., Linden, N.J., developed processes for bonding dry lubricants to space metals; not susceptible to boiloff, these lubricants prevented wear and abrasion and offered additional advantages in the manufacture of spacecraft parts.

The commercial spinoff application of this process resulted in "synergistic" coatings—dry lubricants bonded to a variety of metals to form an extremely hard slippery surface with long-lasting self lubrication. The machine illustrated in the photo is used in the pharmaceutical industry for high speed pressing of pills and capsules.

This machine typifies the type of drug production and packaging equipment whose metal parts are treated with the space spinoff coatings that promote general machine efficiency and contribute to compliance with stringent federal sanitation codes for pharmaceutical manfacture.

Synergistic coatings are especially useful in the pharmaceutical manufacturing industry because they do not react with or contaminate the substances being processed; they are easily cleaned; they prevent production interruption; and they block formation of bacteria pockets.

Although this coating has special applicability in pharmaceutical manufacture, commercial use is broader: coatings are used on machinery used in manufacture of household products, on food processing machinery, and on computers, turbines, pumps and valves.

*NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

NASA
National Aeronautics and Space Administration

For the benefit of all . .

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